REMARKS

This is in response to a first Office Action mailed November 6, 2002. Applicants respectfully traverse and request reconsideration. Applicants wish to thank the Examiner for the Examiner Interview.

Amendments to the Specification

Since the amendments to the specification relate only to correcting minor typographical errors, no amendments were made for reasons related to patentability.

Allowable Subject Matter

The Applicants wish to thank the Examiner for an allowance of claims 18 and 19 and for the notice that claims 4-6 and 13-15 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. For the reasons discussed below, the Applicants respectfully request the rejection to the base claim be withdrawn.

Objection to Claims

Claims 5 and 6 are objected to because they depend upon claim 3, rather than claim 4. Applicants have amended claims 5 and 6 accordingly. Applicants have herein submitted amendments correcting these and other informalities, thus obviating the above-noted objection. Since the amendments to the claims relate only to correcting minor typographical errors, no amendments are made for reasons related to patentability.

Rejection of Claims under 35 U.S.C. § 102(e)

LIU FAILS TO DESCRIBE AT LEAST "FILLING ONLY PIXELS IN THE PORTION OF THE PRIMITIVE THAT IS INSIDE THE SCREEN REGION"

Claims 1-2, 9-12 and 16-17 stand rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. (U.S. Pat. No. 6,144,387) "Liu". The Office Action cites Fig. 4a, Fig. 4b and Col. 5

lines 2-18 for teaching the claim language. Firstly, reference 410, the "display image area" is cited as teaching the screen region. However, Liu teaches:

> The guard memory region corresponds to a set of pixels of the image plane which extends beyond the display image area of the image plane. Pixels can be written to the portions of the guard memory which are not displayed.
>
> (Liu, Col. 3, lines 13 – 17).
>
> Although the rendering system can set pixel values throughout the entire guard memory 510, only those within display image area 410 are utilized by the display hardware for the final display image.

(Liu, Col. 5, lines 22-24). Therefore, unlike the claims, Liu teaches filling pixels "which extends beyond the display image area of the image plane." In contrast, Applicants claim an opposite approach, namely determining which portion of the primitive needs to be rendered and "filling only pixels in the portion of the primitive that is inside the screen region."

Secondly, Liu teaches performing graphics rendering through "hither plane clipping" by projecting a primitive onto an image plane. (Liu Col. 1, line 40 – Col. 2, line 6). Primitives crossing the hither plane are clipped. (Liu Col. 2, lines 1-3). Similarly, "image plane clipping" projects the pixels of a primitive onto an image plane. (Liu Col. 2, lines 7-11). However, these rendering systems, according to Liu, teach that "these **pixels** might not all lie within the area of the image plane which represents the display image." (Liu, Col. 2, lines 8-17) (emphasis added). Accordingly, since Liu requires that "these **pixels** might not all lie within the area of the image plane which represents the display image", unlike the claims, Liu teaches that pixels are filled for primitives outside of the screen region. As a result, Liu fails to teach "filling only pixels in the portion of the primitive that is inside the screen region."

Thirdly, Since Liu teaches clipping the image plane filled with pixels, Liu as best understood appears to teach first filling all of the pixels of the primitive before clipping the primitives, rather than after clipping the primitives. Therefore, unlike the claims, Liu requires

that primitives are completely filled before clipping. In contrast, Applicants claim an opposite approach, namely determining which portion of the primitive needs to be rendered and "filling only pixels in the portion of the primitive that is inside the screen region." Consequently, Liu fails to teach each and every element as arranged in the claims. Therefore, the 102(e) rejection is improper.

Fourthly, Liu teaches a different approach from the claimed invention because, as stated above, Liu teaches filling all of the pixels in a primitive whereas the claims recite "filling only pixels in the portion of the primitive that is inside the screen resion." As a result, at least for the reasons stated above, Liu fails to teach each and every element as arranged in the claims and even teaches against the claims. Consequently, the 102(e) rejection is improper. As discussed during the Examiner interview, the Examiner agreed that the above reasons for overcoming this rejection are sound and will be given full consideration. Accordingly, claims 1-2, 9-12 and 16-17 are believed to be in condition for allowance.

As to claims 2 and 11, Applicants respectfully reassert the relevant remarks made above and further note that at least Liu, as cited, does not teach or suggest "filling only pixels in the portion of the primitive that is inside the screen region." Accordingly, since Liu does not teach "filling only pixels in the portion of the primitive that is inside the screen region," Liu does not teach "the method steps for each primitive of a plurality of primitives. Therefore, the 102(e) rejection is improper, and claims 2 and 11 are in condition for allowance.

Rejection of Claims under 35 U.S.C. 103(a)

NEITHER CHANG NOR LIU EITHER INDIVIDUALLY OR IN COMBINATION, AT LEAST DESCRIBES "FILLING ONLY PIXELS IN THE PORTION OF THE PRIMITIVE THAT IS INSIDE THE SCREEN REGION"

Claims 3 and 7-8 are rejected under 35 U.S.C. 103(a) based on Liu et al. in view of Chang et al. (U.S. Pat. No. 5,040,130) "Chang." However, neither Liu nor Chang, teach "filling only pixels in the portion of the primitive that is inside the screen region." Chang describes "drawing line segment boundary-defined area edges, both real and clipped, and for *filling the interior of said areas*." (Chang, Col. 10, lines 48-50) (emphasis added). Since Chang teaches filling the interior of both the real and clipped boundary-defined areas, Chang as understood, appears to teach first filling of all the pixels of the entire primitive before clipping. In contrast, Applicants claim an opposite approach, namely determining which portion of the primitive that needs to be rendered and "filling only pixels in the portion of the primitive that is inside the screen region." Since neither Chang nor Liu describes "filling only pixels in the portion of the primitive that is inside the screen region" neither reference, either individually or in combination, describes all the elements of the claims. As a result, the Office Action fails to establish a *prima facie* case of obviousness and, therefore, the obviousness rejection under 35 U.S.C. 103(a) is improper.

Regarding claims 7, 9, and 16, Applicants respectfully submit that these claims are at least allowable as depending from the allowable base claim.

Regarding claims 8 and 15, Applicants respectfully submit that these claims are at least allowable as depending from the allowable base claim. Further, Liu as cited in Fig. 4a-b merely shows triangles and does not teach a start point in this figure.

Regarding claims 10, 11, 12, 16 and 17, Applicants respectfully reassert the relevant remarks made above and further note that again Liu fails to teach or suggest "filling only pixels in the portion of the primitive that is inside the screen region." If the rejection is maintained, Applicants also respectfully request a showing in the reference of the respective elements for each claim.

Applicants respectfully submit that the claims are in condition for allowance and respectfully request that a timely Notice of Allowance be issued in this case. The Examiner is invited to contact the below-listed attorney at 312-609-7970 if the Examiner believes that a telephone conference will advance the prosecution of this application.

Respectfully submitted,

By: Themi Anagnos
Themi Anagnos
Registration No. 47,388

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VEDDER, PRICE, KAUFMAN & KAMMHOLZ
222 N. LaSalle Street
Chicago, IL 60601
(312) 609-7500
FAX: (312) 609-5005

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification

Please amend the title of the invention as follows:

[OPTIMIZED PRIMITIVE FILLER OPTIMIZED] PRIMITIVE FILLER FOR GRAPHICS PROCESSING

Please replace the paragraph on Page 5, beginning at line 4, with the following rewritten paragraph:

-- FIG. 1 is a block diagram of a graphics chip 100 operatively connected to a frame buffer 104 and receiving a command stream [101]. In particular, the command stream [101] is received by a graphic[s] processor [103] from other stages in the computer equipment, which are not shown. The command stream contains the information for forming an image on a display. The [G]graphics processor [103] processes the information as known in the art to provide primitives 120 that are representative of the desired image. The primitives 120 are received by a set up engine 108 in a 3D pipeline 102. In the set up engine 108, the x,y coordinates of the primitives 120 are transformed to form screen coordinates. The screen coordinates together with the z coordinate are also referred to as window coordinates. The primitives are then mapped in this window and have x,y coordinates and z coordinates which indicate which primitives are in front of which primitives. These primitives are then passed on to the raster engine 110. The raster engine 110 is also referred to as a scan converter which converts the two dimensional vertices in screen space with at least a z value, a color, and a texture coordinate associated with each vertex into pixels. Unlike previous stages that performed polygon operations, the raster engine stage handles pixel operations. Pixel pipe 112 is operatively connected to the raster engine 110 and a render backend block 114 is operatively connected to the pixel pipe 112. A frame buffer 104, which is connected to the render backend block 114, has at least a color buffer

116 and a z buffer 118. The color buffer 116 stores color information corresponding to pixels in the display frame, and the z buffer 118 stores corresponding z values for the pixels in the display frame.—

Please replace the paragraph on page 10, beginning at line 10, with the following rewritten paragraph:

--For primitive [360] <u>306</u>, the edge walker starts at vertex 330 and proceeds until it identifies point 332 as being the first point of intersection between the primitive 306 and the screen region 300. It is to be understood that once the area within the screen region 300 is identified, the span walker and fill module 206 then take over and fill each of the pixels and the portion of the primitive which is within the screen region 300. This is indicated by the area of the primitives which are filled with lines in FIG. 3. Primitive 308 shows that the edge walker would start at the vertex 340 and proceed to the intersection point 342 at which time the span walker fill module would take over to fill a portion of the primitive 308 which is within the screen region 300. Finally, it is shown how the method of the present invention also works for primitive 310 wherein the start point 350 is within the screen region 300. The equations then cause the span walker and fill module 206 to fill the portion of the primitive 310 which is within the screen region 300 but not the portion of the primitive 310 which is outside of the screen region 300.—

<u>In the claims:</u>

Please substitute the following claims for claims having the same number:

1. (ONCE AMENDED) In a computer system, a method for rasterizing primitives, comprising the steps of:

determining if a primitive is totally outside a predetermined screen region or at least partially within the predetermined screen region;

discarding the primitive if the primitive is totally outside the screen region;

finding at least a portion of the primitive that is inside the screen region if the primitive is not totally outside the screen region; and

filling only pixels in the portion of the primitive that is inside the screen region.

5. (ONCE AMENDED) The method according to claim [3] 4, wherein in the step of finding at least a portion of the primitive that is inside the primitive, given a start point X=XSTART and Y=YSTART for the primitive, the method further comprises the steps of.

(1) incrementing Y if a first value, (((YDIR AND (Y>YBOTTOM)) OR ((YDIR AND (Y<YTOP))), is logically true;

(2) incrementing X if a second value, (((XDIR AND (X>XRIGHT)) OR ((XDIR AND (X<XLEFT))), is logically true; and

(3) repeating steps (1) and (2) until the first and second values are not true, which identifies a beginning of a portion of the primitive that is inside of the screen region.

6. (ONCE AMENDED) The method according to claim [3] 4, wherein in the step of filling the filling is finished when one of the following is true:

(XDIR AND (X < XLEFT)),

(XDIR AND (X > XRIGHT)),

(YDIR AND (Y < YTOP)),

(YDIR AND (Y > YBOTTOM)).

7[,]. (ONCE AMENDED) The method according to claim 1, wherein the method further comprises the steps of:

defining a start point on an edge of the primitive;

determining if the start point is outside the screen region;

edge walking the edge of the primitive from the start point to a boundary of the screen region;

span walking a portion of the primitive inside the screen region and filling each pixel in the portion of the primitive that is inside the screen region.

[15]16.(ONCE AMENDED) The method according to claim 13, wherein the primitive is a triangle and the start point is a vertex of the triangle.

[16]17.(ONCE AMENDED) The method according to claim 10, wherein the primitive is a triangle.

[17]18.(ONCE AMENDED) A graphic primitive clipping system that clips triangular primitives relative to a predetermined screen region, each primitive defined by location values XSTART, YSTART, XEND, YEND, XSTART and XEND defining an X direction extent and location of the primitive in the coordinate system, and YSTART and YEND defining a Y direction extent and location of the primitive in the coordinate system, a screen region defined by limit values XLEFT, XRIGHT, YTOP, YBOTTOM, XLEFT and XRIGHT defining an X direction extent and location of the screen region in the coordinate system, and YSTART and YEND defining a Y direction extent and location of the screen region in the coordinate system, the primitive further defined by first and second x direction values of 0 and 1, respectively, for an x direction XDIR in the coordinate system as, respectively, left to right and right to left relative to the screen region, and first and second y direction values as 0 and 1, respectively, for a y direction YDIR in the coordinate system as, respectively, top to bottom and bottom to top, comprising:

a primitive locator module having an input for receiving primitives and having an output for supplying only primitives that are at least partially within the screen region, primitives

being totally outside the screen area if at least one of the following is logically true given a start point X=XSTART and Y=YSTART for a primitive

XDIR AND ((X<XLEFT) OR (XEND>XRIGHT))

XDIR AND ((X>XRIGHT) OR (XEND>XLEFT))

YDIR AND ((Y<YTOP) OR (YEND>YBOTTOM))

YDIR AND ((Y>YBOTTOM) OR (YEND<YTOP));

an edge walker module having an input operatively connected to the output of the primitive locator module and having an output for supplying data identifying the portion of the primitive inside of the primitive, the edge walker module structured such that at least a portion of the primitive that is inside the primitive, given a start point X=XSTART and Y=YSTART for the primitive, being found by:

(1) incrementing Y if a first value, (((YDIR AND (Y>YBOTTOM)) OR ((YDIR AND (Y<YTOP))), is logically true;

(2) incrementing X if a second value, (((XDIR AND (X>XRIGHT)) OR ((XDIR AND (X<XLEFT))), is logically true; and

(3) repeating steps (1) and (2) until the first and second values are not true, which identifies a beginning of a portion of the primitive that is inside of the screen region;

a span walker having an input operatively connected to the output of the edge walker and an output for supplying filled pixels for pixels in the portion of the primitive inside of the screen region, the span walker having filled all pixels in the portion of the primitive inside of the screen region when one of the following is true:

(XDIR AND (X < XLEFT)),

(XDIR AND (X > XRIGHT)),

(YDIR AND (Y < YTOP)),

(YDIR AND (Y > YBOTTOM)).

[18]19.(ONCE AMENDED) The system according to claim 17, wherein the start point is a vertex of the primitive.